

## **SP-F21 Project Effects on Predation of Feather River Juvenile Anadromous Salmonids**

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### **1.0 Introduction/Background**

The Oroville Facilities, completed in 1968, provide for multiple project purposes including water supply, power generation, flood protection, recreation, and fish and wildlife enhancement. The Oroville Facilities structures and operations may influence juvenile anadromous salmonids directly and indirectly. Project operations may influence anadromous salmonids directly by influencing the flow and water temperature regimes as well as geomorphologic characteristics, such as spawning gravel quality and intergravel permeability. The potential effects of operationally related variables on anadromous salmonids will be addressed in SP-F10. In addition to directly influencing anadromous salmonid habitat, project facilities and operations may influence habitat conditions in the Feather River for predator species that feed on juvenile salmonids, potentially altering predation pressure and possibly resulting in artificially enhanced predation rates on juvenile salmonids. This study plan is designed to characterize the effects of project facilities and operations on predation of juvenile anadromous salmonids.

Project facilities, including dams and other artificial structures, and project operations, including flow and water temperature regimes, may create in-river conditions which are favorable for predators of juvenile anadromous salmonids (Roby et al. 1998, Poe et al. 1994, NMFS 2000). Artificial structures, such as dams, bridges, and diversions can create shadows, turbulence and eddy pools that tend to attract predator species and create an advantage for predators, as well as increased incidence of predation in comparison to natural conditions (Poe et al. 1994, Stevens 1961, Vogel et al. 1988, Decoto 1978). Causes for higher predation risk at these sites may include disorientation of juvenile salmonids by hydraulics at diversions, bypasses and dam spillways; concentration of juveniles near fishways and fish screen bypasses; and creation of pools above and below dams and at diversions, which provide good habitat for pikeminnows (*Ptychocheilus* sp.) and other predators (e.g., Roby et al. 1998). Additionally, artificial impoundments may alter the habitat, and may possible increase the availability of microhabitats preferred by predatory species, such as pikeminnow species (Faker et al. 1988, Beamesderfer 1992, Mesa and Olson 1993, Poe et al. 1994). Project operations or construction of artificial habitat may result in increased water temperature regimes, which may increase digestion and consumption rates of predators (Falter 1969, Steigenberger and Larkin 194, Beyer et al. 1988, Vigg and Burley 1991, Vigg et al. 1991, Brown and Moyle 1981).

Many intensive studies addressing predation on juvenile anadromous salmonids have been conducted on controlled river systems in California and throughout the Pacific Northwest (see existing literature in section 5.0 general approach and section 9.0 references). Generally these studies have focused on predation of juvenile anadromous salmonids relative to project operations, such as altered flow and water temperature regimes, or relative to artificial structures such as dams, diversions, and outlets. Substantial efforts and in some cases decades of study have been applied towards developing explanatory relationships with regards to the effects of project operations or structures on predation of juvenile anadromous salmonids and generally the results are of marginal utility due to the high variability associated with quantification of abundance of and interactions between predator and prey species in open systems, such as rivers. Given the time available for conducting field studies and given the technical difficulties associated with reproducibly, accurately, and

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precisely quantifying the number of predators and prey in open systems (as documented in other predation studies), this study plan will provide a conceptual, qualitative evaluation of effects of operations on predation through review of existing literature. The purpose of this study is to utilize the extensive body of available knowledge to characterize the effects of project operations and artificial structures on predation of juvenile anadromous salmonids by piscivorous fish in the Feather River. In addition to summarizing studies conducted in other river systems, site specific information for the Feather River, including information regarding fish species composition and relative distribution (from SP-F3.2 and SP-F10) and results of previous predation experiments conducted in the Feather River will be incorporated into this study. In addition to providing a conceptual, qualitative evaluation of effects of operations on predation through an extensive review of existing literature, this study plan is designed to support the development of protection, mitigation, and enhancement measures (PM&Es).

The Feather River supports a variety of fish, including anadromous salmonids and potential predators of anadromous salmonids. This study plan will focus on predator and prey species of primary management concern in the Feather River. Prey species of primary management concern are juvenile anadromous salmonids, including Chinook salmon and steelhead. Currently identified predatory species of primary concern in the Feather River include Sacramento Pikeminnow (*Ptychocheilus grandis*) and striped bass (*Morone saxatilis*). As information is accumulated during the literature review regarding fish species that prey upon juvenile anadromous salmonids (Task 3), this list may be expanded to include other fish species present in the Feather River that are documented to predate on juvenile anadromous salmonids. Although this study does not aim to address predation of fish by birds, any relevant information describing avian predation on juvenile anadromous salmonids obtained during the literature review will be incorporated as possible.

As described earlier, project structures potentially influencing predation on juvenile anadromous salmonids include dams, bridges, and diversions, and project operations potentially influencing fish habitat include flow and water temperature regimes associated with project operations. Several Oroville Facilities-related artificial structures in the Feather River have been identified as potential sources of altered predation dynamics including the Fish Barrier Dam and the Thermalito Afterbay Outlet. The Fish Barrier Dam concentrates salmonids by preventing further upstream migration in the main Feather River channel and this concentration may provide conditions, which favor predation. Additionally, the pool formed at the base of the Fish Barrier Dam may create hydraulic conditions, which attract predators. Also, operation of the Thermalito Afterbay Outlet may result in hydraulic characteristics and flow regimes that favor predators. The plunge pool created by the Thermalito Afterbay Outlet outfall may result in a hydraulic regime that favors predators. Additionally, operation of the Thermalito Afterbay Outlet may produce a water temperature regime that favors predators. In addition to project structures, project operations may result in habitat alterations that create favorable in-river conditions for predators. The in-river flow regime associated with project operations may change the in-river pool habitat, create armoring, reduce instream cover or large instream woody debris, or decrease hydrologic diversity of habitat and may result in conditions which provide juvenile salmonids few refuges from predators. Also, the water temperature regime associated with project operations may create thermal conditions, which favor the biological requirements of predators. The literature reviews associated with this study plan will review and summarize studies which investigate the effects of artificial structures and the effects of project operations on predation of juvenile salmonids, with special attention given to those structures and operations which are similar to those of the Oroville Facilities and the Feather River.

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## 2.0 Study Objectives

The purpose of this study is to provide a conceptual, qualitative characterization of the effects of project operations and artificial structures on predation of juvenile anadromous salmonids by piscivorous fish in the Feather River through review of existing literature. Additionally, the study plan will establish tools to evaluate future potential operational scenarios and PM&E measures.

Individual task objectives include:

- Task 1: Describe the life history and habitat requirements of predator and prey species of primary management concern
- Task 2: Summarize existing data describing distribution of predator and prey species of primary management concern in the Feather River
- Task 3: Summarize existing literature investigating predation of juvenile anadromous salmonids associated with artificial structures and project operations in other river basins and determine their applicability to the Feather River
- Task 4: Summarize PM&E measures designed to reduce predation occurring at artificial structures or resulting from project operations and evaluate their potential applicability to the Feather River

## 3.0 Relationship to Relicensing /Need for the Study

This study is needed because project operations influence flow regimes, water temperature regimes, and artificial structures, which may influence predation of juvenile anadromous salmonids within the study area. Artificial structures and project operations associated with the Oroville Facilities may influence predation of juvenile anadromous salmonids by piscivorous fish in the Feather River. Artificial structures may produce turbulence, eddies, and other in-river conditions which are advantageous for predatory species. For example, the Fish Barrier Dam concentrates salmonids by preventing further upstream migration in the main Feather River channel and this concentration may provide conditions, which favor predation. Additionally, flow regimes and water temperature regimes associated with project operations may result in habitat alterations that favor predatory species. Therefore, this study is necessary to characterize project effects on predation of juvenile anadromous salmonids in the Feather River.

Section 4.51(f)(3) of 18 CFR requires reporting of certain types of information in the FERC Application for License for major hydropower projects, including a discussion of the fish, wildlife and botanical resources in the vicinity of the project. The discussion needs to identify the potential impacts of the project on these resources, including a description of any anticipated continuing impact for on-going and future operation of the project. In addition to fulfilling these requirements, information developed in this study plan also may be used in determining appropriate protection, mitigation and enhancement (PM&E) measures.

## 4.0 Study Area

The focus of this study plan will be on artificial structures and habitat alterations associated with the project facilities and operations, which may create in-river conditions that, are favorable for predators. As a result, the geographic extent of this study plan will be partitioned based on the likely ability of operations to control the

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factors influencing predation. Because this study is partially based on the application of studies conducted in other river basins to the Feather River, the geographic scope details the reaches of the Feather River, which will be targeted for application of relevant information. Consideration of potential effects of artificial project structures and project facilities on predation of juvenile anadromous salmonids will include those project structures and facilities within the project boundaries, including the Thermalito Afterbay Outlet and the Fish Barrier Dam. Consideration of potential effects of the water temperature regime on predation of juvenile anadromous salmonids will occur in the Feather River from the Fish Barrier Dam to the confluence with the Yuba River, as the confluence of the Feather and Yuba Rivers is currently considered to be the downstream extent of reasonable control of Feather River water temperature by the Oroville Facilities. However, the study area may be expanded or contracted based on the results of SP-E6, which is designed to determine the downstream extent of reasonable control of Feather River water temperature by the Oroville Facilities. Consideration of potential effects of the flow regime on predation of juvenile anadromous salmonids will occur in the Feather River from the Fish Barrier Dam to the confluence with the Sacramento River, as the flow contribution from project operations extends to the mouth of the Feather River. Study plans approved by the Environmental Work Group define the limits of the study area. If initial study results indicate that the study area should be expanded or contracted, the Environmental Work Group will discuss the basis for change and revise the study area as appropriate.

## **5.0 General Approach**

This plan is a desktop study designed to summarize available information that characterizes the effects of project operations and project-related artificial structures on predation of juvenile anadromous salmonids through a rigorous literature review of predation studies conducted in other river basins and to evaluate their applicability to the Feather River. Tasks 1 and 2 provide information regarding predatory and prey species of primary management concern in the Feather River, while Tasks 3 and 4 review literature from other river basins to support a conceptual, qualitative evaluation of the effects of project operations and structures on predation of juvenile anadromous salmonids and a conceptual evaluation of previously conducted PM&E measures for their applicability to the Feather River. The first task provides a summary of the life history and habitat requirements of predator and prey species of primary management concern in the Feather River. Task 2 summarizes available existing information describing the distribution of predator and prey species of primary management concern and summarizes predation studies conducted on the Feather River. Task 3 summarizes studies conducted in other river basins investigating the effects of project operations and artificial structures on predation of juvenile anadromous salmonids by piscivorous fish and determines the applicability of such studies to the reaches of the Feather River defined in the study area. Determination of applicability of studies will require utilization of information from Tasks 1 and 2. Task 4 will summarize PM&E measures designed to reduce predation resulting from project operations predation at artificial structures and evaluate their potential applicability to the Feather River. As in Task 3, Task 4 will require information from Tasks 1 and 2 to determine applicability of potential PM&Es.

The study plan is structured as a 4-task study. If initial study results indicate that the methods and tasks should be modified, the Environmental Work Group will discuss the basis for change and revise the study plans as appropriate. The study plan is organized into the following four tasks:

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1. Task 1: Describe the life history and habitat requirements of predator and prey species of primary management concern
  2. Task 2: Summarize existing data describing distribution of predator and prey species of primary management concern in the Feather River
  3. Task 3: Summarize existing literature investigating predation of juvenile anadromous salmonids associated with artificial structures and project operations in other river basins and determine their applicability to the Feather River
  4. Task 4: Summarize and report PM&E measures from the literature review that are designed to reduce predation occurring at artificial structures or resulting from hydropower operations and evaluate their potential applicability to the Oroville Facilities operations.

In order to achieve the final objective of providing a conceptual, qualitative characterization of the effects of operations on predation of juvenile anadromous salmonids, information from many sources must be integrated and summarized. The following list of information sources is not intended to be exhaustive, but to provide an overview of the types of studies available that have investigated the effects of project structures and operations on predation of juvenile salmonids. Additionally this list of available information includes monitoring and evaluation of PM&E programs designed to control or minimize predation on juvenile anadromous salmonids. Literature review may include, but is not limited to, the following existing sources:

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- Beamesderfer, R.C., D.L. Ward, and A.A. Nigro. 1996. Evaluation of the biological basis for a predator control program on northern squawfish (*Ptychocheilus oregonensis*) in the Columbia and Snake Rivers. *Canadian Journal of Fisheries and Aquatic Sciences* 53:2898-2908.
- Beamesderfer, R.C. 1992. Reproduction and early life history of northern squawfish, (*Ptychocheilus oregonensis*) in Idaho's St. Joe River. *Environmental Biology of Fishes* 35:231-241.
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  - Buchanan, D.V., R.M. Hooton, and J.R. Moring. 1981. Northern squawfish (*Ptychocheilus oregonensis*) predation on juvenile salmonids in sections of the Willamette River Basin, Oregon. Canadian Journal of Fisheries and Aquatic Sciences 38:360-364.
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  - California Department of Fish and Game. 1994. Predator sampling near the salinity control structure site in Montezuma Slough, May 1993. Bay-Delta Division. April 5.
  - Chandler, J.A., 1993. Consumption rates and estimated total loss of juvenile salmonids by northern squawfish in Lower Granite Reservoir, Washington. Master's thesis, University of Idaho.
  - Cramer, S.P. 1992. The occurrence of winter-run Chinook in the Sacramento River near the intake of the Glenn-Colusa Irrigation District. Submitted to Glenn-Colusa Irrigation District, March 1992. Sacramento, CA.
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### ***Detailed Methodology and Analysis***

#### **Task 1-Describe the Life History and Habitat Requirements of Predator and Prey Species of Primary Management Concern**

This task consists of compiling the summary of life history and habitat requirements of predator and prey species of primary management concern from supporting FERC study plans. Life history and habitat requirements for predator and prey species of primary management concern will be summarized in SP-F3.2 and SP-F10, respectively. If required, the life history and habitat requirements from SP-F3.2 and SP-F10 may

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be supplemented with additional literature review to obtain additional information regarding predation-related characteristics, such as predation rates or feeding habits. Information detailing the specific life history periodicities (e.g., adult spawning, juvenile rearing and migration), general habitat requirements (warmwater or coldwater, bottom or pelagic, lentic or lotic dwellers), specific habitat requirements (e.g., water depth, water velocity, substrate composition), and community interactions (predators, prey, competitors) of prey and predatory fish species of primary management concern will be utilized by Tasks 3 and 4 in determining the applicability of predation studies and PM&E measure conducted in other river basins to the Feather River. Information regarding the habitat requirements and life history characteristics will be obtained from available general scientific literature, and data and reports from studies conducted by federal and state agencies. As stated earlier, it is anticipated that the literature reviews in SP-F3.2 and SP-F10 will provide the majority of the information needed for completion of this task. Contingent on the information available, this review will include the following topics:

- Habitat requirements by lifestage (habitat types, water temperatures, water depth, water velocity, substrate, etc.);
- Life history characteristics (spawning, juvenile rearing and migration timing, life-span, growth, mortality);
- Adult migration and holding habitat and characteristics (timing, water temperature and flow conditions, holding habitat);
- Spawning characteristics (habitat availability, timing, and factors affecting timing and success such as substrate conditions and water temperatures);
- Early development (factors affecting incubation and survival during incubation);
- Juvenile rearing (water temperature, flow, substrate characteristics, refuges, shade, cover, food availability);
- Juvenile movements (timing, prevalent flow, water temperature and other abiotic conditions, predation, stranding);
- Predator diet by size or age group and predation rates by size, lifestage and water temperature; and
- Association of predators to physical facilities or habitat conditions created by project operation (instream obstructions and diversions, unusual flow or water-temperature patterns).

Anticipated deliverables include tables or figures describing the life history of predator and prey species of primary management concern, and tables, figures, or narratives documenting habitat predation-related characteristics. The final report integrating the information detailed above will be completed by December 2002.

#### Task 2-Summarize Existing Data Describing Distribution of Predator and Prey Species of Primary Management Concern in the Feather River

This task consists of a general review of existing information sources including related Oroville Facilities FERC relicensing study plan results, as well as additional reports or studies by federal and state agencies, scientific papers, creel census reports, and other miscellaneous sources such as regional newspapers and possible interviews with private parties in the Central Valley, to document distribution of prey and predator species of primary management concern in the Feather River. For predator species of primary management concern, the summary of existing information regarding fish distribution will be supplied by Task 1 of SP-F3.2. As described in Task 1 of SP-F3.2, if existing, relevant data has not been analyzed and incorporated into existing reports it may be examined as a supplemental effort to improve our knowledge of fish distribution in

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the Feather River. For example, although data describing the relative distribution of pikeminnow is obtained during DWR snorkel surveys, it is not necessarily included in summary reports. Such raw data will be examined, analyzed, and incorporated as appropriate for describing the relative distribution of pikeminnow. Additionally, data collected as part of creel surveys, but not reported in the original report, may be re-examined for distribution data for fish that were observed during the effort, but that were not the target of analysis, and therefore not included in the report. An example of this type of data mining analysis is to utilize existing creel data for angler catch rates for striped bass to determine striped bass distribution. For prey species of primary management concern, distribution data will be obtained from many sources including broad-scale snorkel surveys (Task 3A of SP-F10), existing seining data, rotary screw trap data (Task 4A of SP-F10), fyke trap data, and creel surveys (SP-R13). As available, data describing abundance of predator and prey species of primary management concern in the Feather River will be incorporated. Additionally, any experiments conducted in the Feather River regarding predation of juvenile anadromous salmonids by piscivorous fish will be summarized under this task. This summary includes review of the tethering study conducted by DWR in summer of 1999. This experiment measured frequency of predator attacks on live, tethered bait fishes at various locations and in different habitat in the Feather River. The results of Task 2, in conjunction with the results of Task 1, will facilitate the assessment of applicability of results of studies conducted in other river basins (Tasks 3 and 4) to the Feather River.

A draft report describing the findings of Task 2 following the first year of data collection (snorkel surveys, existing seining data, rotary screw trap data, fyke trap data, and creel surveys) will be completed by December of 2002. The final report will incorporate results of 2003 field study efforts (rotary screw traps, snorkel survey, creel survey data) and will be completed by December of 2003. Anticipated deliverables include maps, figures, narratives, or tables showing geographic and temporal distributions of predator and prey species of primary management concern, and including abundance information as available.

Task 3-Summarize existing literature investigating predation of juvenile anadromous salmonids associated with artificial structures and project operations in other river basins and determine their applicability to the Feather River

In Task 3, studies conducted in other river basins investigating the effects of project structures and operations on predation of juvenile salmonids will be summarized and evaluated for their applicability to the Feather River. A preliminary list of studies to be investigated may include but is not limited to those listed under section 5.0 General Approach. In cases where local or regional predation studies have been conducted, those studies will be summarized and evaluated for applicability to the Feather River. Studies conducted in other Central Valley rivers are generally expected to be relatively applicable to the Feather River. In cases where local information regarding predation requires supplementation, studies regarding predation from other geographic areas, including river systems in Washington and Oregon, will be summarized and will be reviewed for their applicability to the Feather River. Following summary of study results, the applicability of these study results to the Feather River will be assessed by considering the following: similarity of habitat; similarity of predator and prey species present; similarity of types of artificial structures; similarity of hydraulics associated with artificial structures; similarity of operational patterns including seasonal flow fluctuations, water temperatures and resulting habitat alterations; and similarity of ecosystem structure.

The applicability of results of existing studies completed on other river basins will be assessed through qualitative evaluation of the similarity of the physical, biological and hydraulic characteristics of the studied river system, artificial structures, and operational patterns to those in the Feather River. The results of Tasks 1

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and 2, will be used to determine similarity of the biological characteristics of other river basins to the Feather River. Operations reports, engineering diagrams, existing reports and studies, and data from other FERC relicensing study plans will be utilized, as appropriate, to provide supporting information regarding the physical and hydraulic characteristics of the Feather River. In some cases, entire studies conducted in other river basins may not be directly applicable to the Feather River, but site-specific investigations of predation, particularly at project structures or relating to specific project operations such as flow or water temperature manipulations, may be applicable to similar structures or operations in the Feather River. When study results are applicable to the Feather River system based on similarities considered above, the effects of operations and artificial structures on predation described in those studies will be used to conceptually evaluate the effects of project operations and artificial structures on predation in the Feather River. As an additional component of the desktop investigation, this task will summarize and report PM&E measures, as identified from the literature review, which have been designed to reduce predation risks for other projects as a means of providing supplemental guidance to assist in the development of potential PM&Es for this project. This evaluation is designed to support the development of potential PM&Es by applying to the Feather River the results of studies investigating predation on juvenile anadromous salmonids and related conclusions regarding effects of project operations and structures on predation of juvenile salmonids from similar river systems.

Anticipated deliverables include narratives, tables, or figures summarizing results of predation studies conducted in other river basins and narratives describing the applicability of those studies to the Feather River system. The final report describing the findings of Task 3 will incorporate results of Tasks 1 and 2 and will be completed by December of 2003.

Task 4- Summarize and report PM&E measures from the literature review that are designed to reduce predation occurring at artificial structures or resulting from hydropower operations and perform a reconnaissance level evaluation of their potential applicability to the Oroville Facilities operations.

The objective of Task 4 is to compile and summarize PM&E efforts designed to reduce predation or control predatory fish and to evaluate the success of such measures as well as their potential applicability to the Feather River. This task is designed to support the identification of potential PM&Es by summarizing previously implemented PM&Es designed to reduce predation on juvenile anadromous salmonids from other river systems and assessing their potential applicability to the Feather River. A preliminary list of PM&Es to be investigated may include but is not limited to those listed under section 5.0 General Approach. For each PM&E measure, the implementation methodology and the result of monitoring studies designed to determine the effectiveness of the PM&E will be reviewed and summarized. Applicability of PM&Es conducted in other river basins to the Feather River will be evaluated qualitatively using considerations described in Task 3, and the degree of applicability will be used to conceptually evaluate the potential value associated with implementing a similar PM&E in the Feather River. Anticipated deliverables include narratives, tables, or figures summarizing results of PM&E implementation and monitoring studies conducted in other river basins and narratives describing the applicability of those studies to the Feather River system. An interim report describing the findings of Task 4 will be completed by December of 2002 and the final report will be completed by December of 2003.

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Phase 2-Field data collection designed to characterize hydraulic, biological, or physical characteristics associated with artificial structures, project operations, or habitat alterations

If additional field studies are deemed to be required following the Environmental Work Group's review of the Phase 1 deliverable, then a detailed plan for supplemental field data collection will be developed to characterize the hydraulic, biological or physical characteristics associated with artificial structures, project operations, or habitat alterations in the Feather River in order to assess the applicability of previously conducted predation studies to the Feather River system. After consideration of the Phase 1 deliverable, any additional required fieldwork will be specified by the Environmental Work Group.

## **6.0 Results and Products/Deliverables**

### ***Results***

Results will be organized following the task headings. Each task will include a narrative of the relevant findings as well as tables, figures and maps summarizing the key points. After the results of the four individual tasks are presented, the relationships among the findings of the four sections will be identified to provide general answers to the main questions of the study. The anticipated maps, graphical representation of reviewed data (e.g., charts, and graphs) and summary figures and tables include:

- Tables or figures describing the life history of predator and prey species of primary management concern, and tables, figures, or narratives documenting habitat predation-related characteristics (Task 1);
- Maps, figures, narratives, or tables showing geographic and temporal distributions of predator and prey species of primary management concern, and including abundance information as available (Task 2);
- Narratives, tables, or figures summarizing results of predation studies conducted in other river basins and narratives describing the applicability of those studies to the Feather River system (Task 3); and
- Narratives, tables, or figures summarizing results of PM&E implementation and monitoring studies conducted in other river basins and narratives describing the applicability of those studies to the Feather River system (Task 4).

### ***Products/Deliverables***

The study plan summary report will include:

- Executive Summary
- Table of Contents
- List of Tables
- List of Figures
- Introduction
- Methodology
- Narratives of relevant findings by task
- Discussion addressing most relevant questions (see above) and indicating any complications/data concerns
- Conclusions related to study plan goals and objectives
- References
- Appendices

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## 7.0 Coordination and Implementation Strategy

### *Coordination with Other Resource Areas/Studies*

It is anticipated that this study will require coordination with those individual responsible for collecting temperature and project operation data, performing biological surveys, and hydraulic and channel morphology studies. Given the nature of the tasks of this study, coordination with work groups directing and conducting other studies relevant to the Oroville Facilities FERC Relicensing Project also will be required. A preliminary list of study plans that will be related to the development of the present study are discussed below.

- SP-F3.2-Evaluation of Project Effects on Non-salmonid Fish in the Feather River Downstream of the Thermalito Diversion Dam

SP-F3.2 will provide Task 1 of SP-F21 with life history and habitat requirements of predatory fish of primary management concern. Information detailing the specific life history periodicities (e.g., adult spawning, juvenile rearing and migration), general habitat requirements (warmwater or coldwater, bottom or pelagic, lentic or lotic dwellers), specific habitat requirements (e.g., water depth, water velocity, substrate composition), and community interactions (predators, prey, competitors) of prey and predatory fish species of primary management concern will be supplied by SP-F3.2 as specified in Task 2 of SP-F3.2. Additionally, SP-F3.2 will provide Task 2 of SP-F21 with distribution and species composition of predatory of primary management concern as specified in Task 1 of SP-F3.2. As described in Task 1 of SP-F3.2, fish distribution and species composition data will come from many sources including snorkel surveys (broad-scale), existing seining data, rotary screw trap data, fyke trap data, and creel surveys. In addition to data summarized in reports and scientific papers, data that has not yet been summarized is expected to provide additional useful information, and if existing, relevant data that has not been analyzed and incorporated into existing reports it may be examined under Task 1 of SP-F3.2 to provide supplemental information regarding fish distribution in the Feather River.

- SP-F10—Evaluation of Project Effects on Salmonid Fish and their Habitat

Various subtasks under Tasks 1, 2, 3 and 4 in SP-F10 will provide Task 1 of SP-F21 with results of literature reviews detailing the life history and habitat requirements for prey species of primary management concern. Task 3A and 4A of SP-F10 will provide Task 2 of SP-F21 with distribution and, when available, abundance information regarding prey species of primary management concern. Distribution data will be obtained from many sources including broad-scale snorkel surveys (Task 3A of SP-F10), existing seining data, rotary screw trap data (Task 4A of SP-F10), and fyke trap data.

- SP-R13-Recreation Surveys

Creel surveys conducted by SP-R13 will provide Task 2 of SP-F13 with information regarding the distribution of prey and predator species of primary management concern.

### *Issues, Concerns, Comments Tracking and/or Compliance Requirements*

***This study fully or partially addresses the following Stakeholder issues:***

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**Stakeholder Issues Fully Addressed by SP-F21 Project Effects on Predation of Feather River  
Juvenile Anadromous Salmonids**

<b>Issue</b>	<b>Issue Statement</b>
FE22	Prevent Northern Pike from entering Lake Oroville by eliminating them from the licensee's upstream impoundments. If Northern Pike enter Lake Oroville and the Feather River watershed, aggressively address the problem and successfully eliminate the fish.
FE75	Project structures or operations that either have in the past, or continue to introduce predators, create suitable habitat for predators, harbor predators, or are conducive to the predation of salmonids.
FE76	Prevent the introduction of new piscivorous (fish-eating) predators (e.g., northern pike, striped bass, white bass, etc.) introductions to project waters.

*Source: NEPA Scoping Document 1 and CEQA Notice of Preparation, DWR 2001.*

**Stakeholder Issues Partially Addressed by SP-F21 Project Effects on Predation of Feather River  
Juvenile Anadromous Salmonids**

<b>Issue</b>	<b>Issue Statement</b>
F16	Effects of existing and future project facilities and operations on the abundance of predators, their seasonal and geographic distribution, the impact of predation mortality on population dynamics of salmonids and other species, and alternatives for predator control and management (including prevention of introductions); also addressed in SP-F3.1, SP-F3.2, and SP-F5/7.
FE77	Predation of fish species naturally occurs under all conditions. However, project conditions could exacerbate the occurrence of predation on certain species. Changes in license conditions could lead to an unnecessary increase in predation on desirable gamefish or threatened and endangered species, or other species of concern. Occurrence (habitat, distribution and numbers of predator fish should be identified in all riverine waterways affected by project releases. Predation investigations should be comprehensive, and predator management should be available as a fishery management tool; also addressed in SP-F3.2.
FE94	Evaluate the potential impacts of striped bass predation mortality on juvenile Chinook salmon and steelhead within the lower Feather River and the effects of project operations on predator-prey interactions, and identify and evaluate alternative methods for controlling and reducing predation mortality by species such as striped bass on juvenile rearing and emigrating salmonids; also addressed in SP-F5/7.

*Source: NEPA Scoping Document 1 and CEQA Notice of Preparation, DWR 2001.*

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## 8.0 Study Schedule

Task	Timing/Deadlines		
	Literature Reviews occurring in SP-F21	Interim Report	Final Report
1	Description of life history and habitat requirements of predator and prey species of primary management concern	N/A	December 2002
2	Summary of existing data describing distribution of predator and prey species of primary management concern	December 2002	December 2003
3	Summary of existing predation studies conducted in other river basins and evaluation of their applicability to the Feather River	N/A	December 2003
4	Summarize and report PM&E measures from the literature review that are designed to reduce predation occurring at artificial structures or resulting from hydropower operations and evaluate their potential applicability to the Oroville Facilities operations	December 2002	December 2003

## 9.0 References

A complete list of references used in the completion of the study will be part of the summary report. The references cited in the present plan are listed below.

Beamesderfer, R.C. 1992. Reproduction and early life history of northern squawfish, (*Ptychocheilus oregonensis*) in Idaho's St. Joe River. Environmental Biology of Fishes 35:231-241.

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